

FORM PTO-1390
(REV 3/2001)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

**TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371**

DATE: March 1, 2002

EXPRESS MAIL LABEL NO.

107070077

ATTORNEY DOCKET NO.
47968/DBP/S307

U.S. APPLICATION NO.
N/A

INTERNATIONAL APPLICATION NO
PCT/GB00/03302

INTERNATIONAL FILING DATE
August 30, 2000

PRIORITY DATE CLAIMED
September 1, 1999

TITLE OF INVENTION

APPARATUS AND METHODS OF DETECTING AND CONTROLLING TWISTS IN MULTICORE CABLES

APPLICANT(S) FOR DO/EO/US

FLEMING, Patrick, and HASSAN, Halil, Giray

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2)).
 - a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☒ has been transmitted by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/LUS).
6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210).
8. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).
 - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau)
 - b. ☐ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☐ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). (UNEXECUTED)
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5))

Items 13 to 20 below concern document(s) or other information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification
18. ☐ A change of power of attorney and/or address letter
19. ☐ **SMALL ENTITY** Assertion Applicant(s) and any other associated with it/them under 37 CFR § 1.27(a) are a small entity
20. ☒ Certificate of Mailing by Express Mail
21. ☒ Other items or information: A.) Extra Set of Drawings B.) Incorporation of Annexes to IPER and Int'l. Appln

U.S. APPLICATION NO. (If known, see 37 CFR 1.5) N/A 10/070077		INTERNATIONAL APPLICATION NO PCT/GB00/03302		ATTORNEY DOCKET NO. 47968/DBP			
21. The following fees are submitted: <input type="checkbox"/> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO: \$1,040.00 <input checked="" type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO \$890.00 <input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$740.00 <input type="checkbox"/> International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) \$710.00 <input type="checkbox"/> International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00				CALCULATIONS		PTO USE ONLY	
ENTER APPROPRIATE BASIC FEE AMOUNT =				\$ 890			
Surcharge of \$130 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input checked="" type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$ 130			
Claims	Number Filed	Number Extra	Rate				
Total Claims	3 -20=	0	X \$18	\$			
Independent Claims	2 -3=	0	X \$84	\$			
Multiple dependent claim(s) (if applicable)			+ \$280	\$			
TOTAL OF ABOVE CALCULATIONS =				\$ 1,020			
Reduction by 1/2 for filing by small entity, if applicable. Verified Small entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).				\$			
SUBTOTAL =				\$ 1,020			
Processing fee of \$130 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$			
TOTAL NATIONAL FEE =				\$ 1,020			
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property				\$			
TOTAL FEES ENCLOSED =				\$ 1,020			
Note (1): The basic national fee must be paid when filing this application. The 20-month time limit (37 CFR § 1.494) and 30-month time limit (37 CFR § 1.495) are not extendable.				Amount to be refunded \$			
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a. <input checked="" type="checkbox"/> A check in the amount of \$ 1,020.00 to cover the above fees is enclosed. b. <input type="checkbox"/> Please charge my Deposit Account No. _____ in the amount of \$ _____ to cover the above fees. A duplicate copy of this sheet is enclosed. c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 03-1728 . A duplicate copy of this sheet is enclosed.							
NOTE (2): Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.							
SEND ALL CORRESPONDENCE TO: D. Bruce Prout CHRISTIE, PARKER & HALE P.O. Box 7068 Pasadena, CA 91109-7068 CUSTOMER NUMBER: 23363							
				By <u><i>D. Bruce Prout</i></u> D. Bruce Prout Reg. No. 20,958			

1007007710/070077

JC19 Rec'd PCT/PTO 01 MAR 2002

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

EXPRESS MAIL NO. EL717377815US

Applicant : Patrick Fleming, et al.
Application No. : N/A
Filed : March 1, 2002
Title : APPARATUS AND METHOD OF DETECTING AND
CONTROLLING TWISTS IN MULTICORE CABLES

Docket No. : 47968/DBP/S307

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Post Office Box 7068
Pasadena, CA 91109-7068
March 1, 2002

Commissioner:

Please amend the above-identified application as follows:

IN THE SPECIFICATION

After the title please add the following:


--CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority of International patent application No. PCT/GB00/03302, filed on August 30, 2000, which in turn claims priority to British patent application No. 9920588.2, filed on September 1, 1999.--

REMARKS

In view of the foregoing amendment, consideration and allowance of this application is respectfully requested.

Respectfully submitted,
CHRISTIE, PARKER & HALE, LLP

By 
D. Bruce Prout
Reg. No. 20,958
626/795-9900

DBP/aam

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APPARATUS AND METHODS OF DETECTING AND CONTROLLING TWISTS IN MULTICORE CABLES

The present invention relates to methods and apparatus for detecting and controlling
5 twists in multicore cables.

Cables used for telecommunication and other high technology applications are
required to be manufactured to high specifications since the way in which two or more
conductors are twisted together can effect attenuation and crosstalk.

10

Generally, cables which have two or more conductors twisted together rely on the
apparatus generating the twist to ensure that the twisting takes place in a regular and
uniform manner. However, in practice, the twist produced will vary and this in turn will
vary the attenuation within the conductors and the crosstalk between them.

15

It is an object of the present invention to provide apparatus and method of
measuring the twist in a twisted cable as it is being manufactured so that with the aid of
feedback, the twisting action can be modified to reduce non-uniformity towards zero.

20

According to the present invention, there is provided apparatus for detecting the
twist in a multistrand or multicore cable into which a nominal twist per unit length is
introduced, the apparatus comprising means for measuring the speed at which the cable

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travels and producing a reference signal having a frequency equal to the nominal twist rate of the cable, means for measuring the variation of a transverse dimension of the cable when viewed from a fixed point near which the cable passes, to produce an output signal including a frequency component equal to the twist frequency, an analyser for conducting
5 an analysis on the output and conditioned by the reference signal to output only a measurement signal having said twist frequency.

The analysis may be a Fourier analysis, or a timing analysis, or other type of analysis.

10

According to the present invention, there is further provided a method of detecting twist in a multistrand or multicore cable comprising the steps of monitoring the variation in profile of the cable as it passes a predetermined location to produce a measurement signal having a frequency component equal to the actual frequency of twist, determining the
15 nominal twist frequency of the cable, conducting an analysis of the measurement signal and with the aid of the nominal twist frequency separating out from the measurement signal the component having the actual frequency of twist.

According to the present invention there is still further provided apparatus for
20 detecting the speed and twist rate in a cable having at least two twisted elongate elements and travelling along a predetermined path, the apparatus comprising first and second sensors spaced apart along said path by a predetermined distance, each sensor comprising a light source and detection means positioned about said path so that the cable interrupts the

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light path from the source to the detector means to cast a varying shadow on the detector as the cable travels along the predetermined path, and means for processing the outputs of the two detector means to determine the actual speed and twist rate or the deviation, if any, from the actual speed and twist rate.

5

The outputs of the detector means may be used in conjunction with a nominal speed and twist rate for the cable, to determine the actual speed and twist rate or deviation.

Apparatus and methods for detecting and controlling the twists in multicore cables,
10 will now be described, by way of example, with reference to the accompanying
diagrammatic drawings, in which:

Figure 1 is a plan view of the apparatus;

Figure 2 is a front elevation of the apparatus of Figure 1;

Figure 3 is a view from one side of the optical detection system of the apparatus of
15 Figures 1 and 2; and

Figure 4 is a front elevation of another apparatus embodying the invention.

Figure 1 shows part of the twisted cable production line. Individual strands or
conductors are taken from separate supply reels (not shown) and fed through a twisting
20 assembly 2 in which orbital rotary components (not shown) produce a twist in the cable.
The twisted cable 4 emerging from the assembly 2 passes over a pair of spaced supporting
wheels 6 and 8. A detection arrangement 10 straddles the cable as it passes between the
wheels 6 and 8.

- 4 -

The shaft of the wheel 6 is coupled to a transducer 12 which provides an output proportional to the speed of the wheel which in turn is dependent upon the speed of travel of the cable 4.

5 The output of the transducer 12 is fed to a calibration unit 14. The calibration unit has an adjustable input which can be set to the nominal number of 360° twists that the twisting assembly induces per unit length of the cable. The frequency f_{ref} of the output signal of the calibration unit is thus arranged to equal nominal rate or frequency at which the conductors turn about each other (the twist frequency) as they pass over the wheel 6.

10

A detection assembly 10 downstream of the wheel 6 measures the variation in the lateral dimension of the cable as the conductors twist about each other and the resultant signal produced will include a number of frequency components including the actual twist frequency of the cable. The output of the detection assembly 10 is fed to an analyser 18
15 which conducts a Fourier analysis on the input signal. The analyser 18 also receives the reference frequency f_{ref} which it uses to establish a bandwidth to select only the actual twist frequency component f_t from the multitude of different frequency components established by the Fourier analysis.

20

Other types of analysis may be used, eg timing analysis.

This twist frequency component f_t is fed together with the reference frequency f_{ref} to comparator 20 which produces a difference signal f_d . The difference signal of frequency f_d

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is fed back to the twisting assembly which responds by adjusting the twisting action in a sense to reduce the difference to zero.

Figure 3 shows the detection assembly 10 in more detail. As shown, a light emitter 22, on one side of the cable 4, is directed at a light receiver 24 in the opposite side of the cable. A first lens 26 located between the emitter 22 and the cable produces parallel rays of light, some of which are interrupted by the cable 4. Another lens 28 between the cable 4 and the receiver 24 receives the non-intercepted light and focuses the rays on the receiver 24.

10

As can be seen as the twist progresses, the amount of light intercepted by the cable will vary and so will the shadow cast by the light on the receiver 24. Hence, the output signal from the receiver will have a frequency component equal to the twist frequency.

15 The apparatus shown in Figure 4 is arranged to provide a first output indicative of the twist rate of a cable consisting of twin twisted strands or conductors and a second output indicative of the speed of the cable. Both of these parameters can be used in feedback systems to control the production of the cable.

20 As shown, the twisted cable 36, emerging from a twisting assembly 30, is supported by a downstream roller 32. A light shield 34 extending above the cable 36 is provided with two slots 34A and 34B spaced apart in the longitudinal direction of the cable 36 and extending tangential to the cable.

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A light shield 38 extending below the cable 36 is also provided with two slots 38A and 38B spaced apart in the longitudinal direction of the cable and extending tangential to the cable. The slots 34A and 34B are in direct alignment with respective slots 38A and 38B.

5

A light source 40 projects a beam of light through slots 34A and 38A and a photo-detector 42 receives the light emerging from the slot 38A. Similarly, a light source 46 projects a beam of light through the slots 34B and 38B and a photo-detector 48 receives the light emerging from the slot 38B.

10

A filter 50 is connected to receive the output from the detector 44 and passes a signal having a frequency over a specific range.

A filter 52, similar to the filter 50, is connected to receive the output of the photo-
15 detector 48. A phase comparator 54 is connected to the outputs of the two filters 44 and 48 and provides a phase difference or error signal at an output terminal 56.

A processor 58 receives the output of the filter 50 to provide a speed or speed error signal at output terminal 60.

20

In operation, as the twisted cable passes between respective pairs of slots 34A, 38A and 34B and 38B, it will present a varying profile and so the shadow it casts on respective photo-detectors 44 and 48, will vary in a generally sinusoidal manner. The output signal

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from the detectors will thus include a selected frequency component related to the speed of the cable, assuming the twist rate remains constant. Any variation in the twist rate will manifest itself in a phase change in selected frequency components in the outputs of the two detectors 44 and 48.

5

The two filters 50 and 52 are arranged to have a relatively narrow passband having a centre frequency corresponding to the nominal twist frequency of the cable when run at nominal speed. The processor 58, upon receiving the output signal from the filter 50, converts it into a speed signal which is then fed to the output 60. Instead, the processor 58 may compare the output signal from the filter 50 with a nominal value and then feed an error signal to the output 60.

10

The phase comparator 54 compares the phases of the two output signals from the filters 50 and 52 and provides a difference signal at output 56. Instead, the comparator may compare the phase difference with a nominal phase difference and feed an error signal to the terminal 56.

15

The signals at the outputs 60 and 56 can be fed back to the assembly 30 to maintain the speed and twist rate of the cable substantially constant.

20

It will be appreciated that while the detection assembly is described as an optical sensor, other sensors which can detect a change in the twist of the cable can equally be used, for example, a capacitive or ultrasonic detection system.

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In some embodiments, it may not be necessary to determine the nominal twist frequency and twist rate for a cable.

CLAIMS

1. Apparatus for detecting the speed and twist rate in a cable having at least two twisted elongate elements and travelling along a predetermined path, the apparatus
5 comprising a first sensor having a light source and detection means positioned about said path so that the cable interrupts the light path from the source to the detector means to cast a varying shadow on the detection means as the cable travels along the predetermined path, and means for processing the outputs the detection means with the actual speed of the cable to determine the actual twist rate for the cable, characterised by a second sensor spaced
10 apart along said path a predetermined distance from said first sensor, the second sensor having a light source and detection means positioned about said path so that the cable interrupts the light path from the source to the detection means to cast a varying shadow on the detection means as the cable travels along the predetermined path, and in that the processing means determines said actual speed of the cable from the outputs of said first
15 and second sensors.
2. Apparatus according to Claim 1, including for each sensor, a filter having a passband based around a frequency corresponding to the speed of the cable along said predetermined path.
20
3. A method for detecting the speed and twist rate in a cable having at least two twisted elongate elements and travelling along a predetermined path, the method comprising the step monitoring the variation in profile of the cable as it passes a first location along said path to provide a first measurement signal and processing the first
25 measurement signal with a signal representative of the actual speed of the cable to

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determine the twist rate characterised by the step of monitoring the variation in profile of the cable as it passes a second location along said path spaced a predetermined distance from said first location to produce a second measurement signal, and processing the first and second measurement signals to produce therefrom said signal representative of the

5 actual speed of the cable.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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PCT

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(21) International Application Number: **PCT/GB00/03302**

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9920588.2 1 September 1999 (01.09.1999) GB

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(71) Applicant (*for all designated States except US*): **BETA LASERMIKE LIMITED** [GB/GB]; Stirling Road, Cressex Business Park, High Wycombe, Buckinghamshire HP12 3RT (GB).

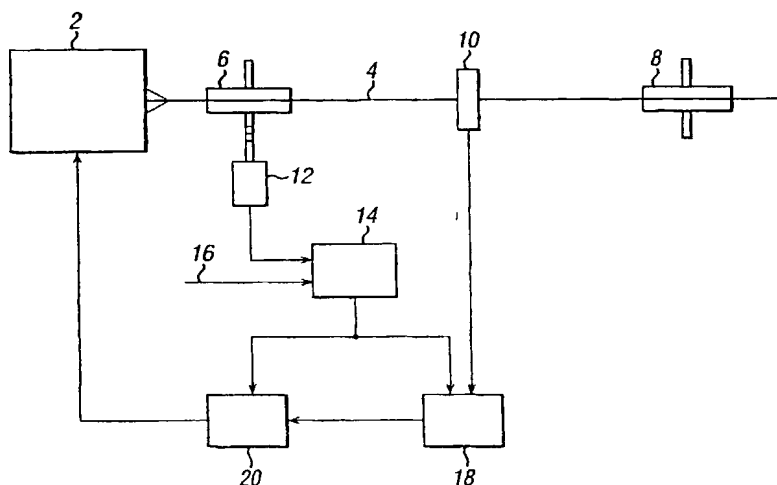
(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

— Without international search report and to be republished upon receipt of that report.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: **APPARATUS AND METHODS OF DETECTING AND CONTROLLING TWISTS IN MULTICORE CABLES**



(57) Abstract: The apparatus includes a transducer (12) coupled to a wheel driven by the cable (4) to indicate the speed of travel of the cable. A calibration unit (18) converts this speed in collaboration with a nominal twist rate set into the unit, into an output signal having a frequency equal to the nominal twist frequency of the cable. A detection assembly (10) downstream of the wheel (6) detects the variations in thickness of the twisted cable as it passes and thus produces a signal having a frequency component directly related to the actual twist rate. An analyser (18) conducts a Fourier analysis on the output of the detector and, with the aid of the nominal twist frequency, is able to select the frequency component representative of the actual twist frequency. The actual twist frequency is compared with the nominal twist frequency by a comparator (20) and the resulting difference signal is fed back to the twisting assembly.

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FIG. 1

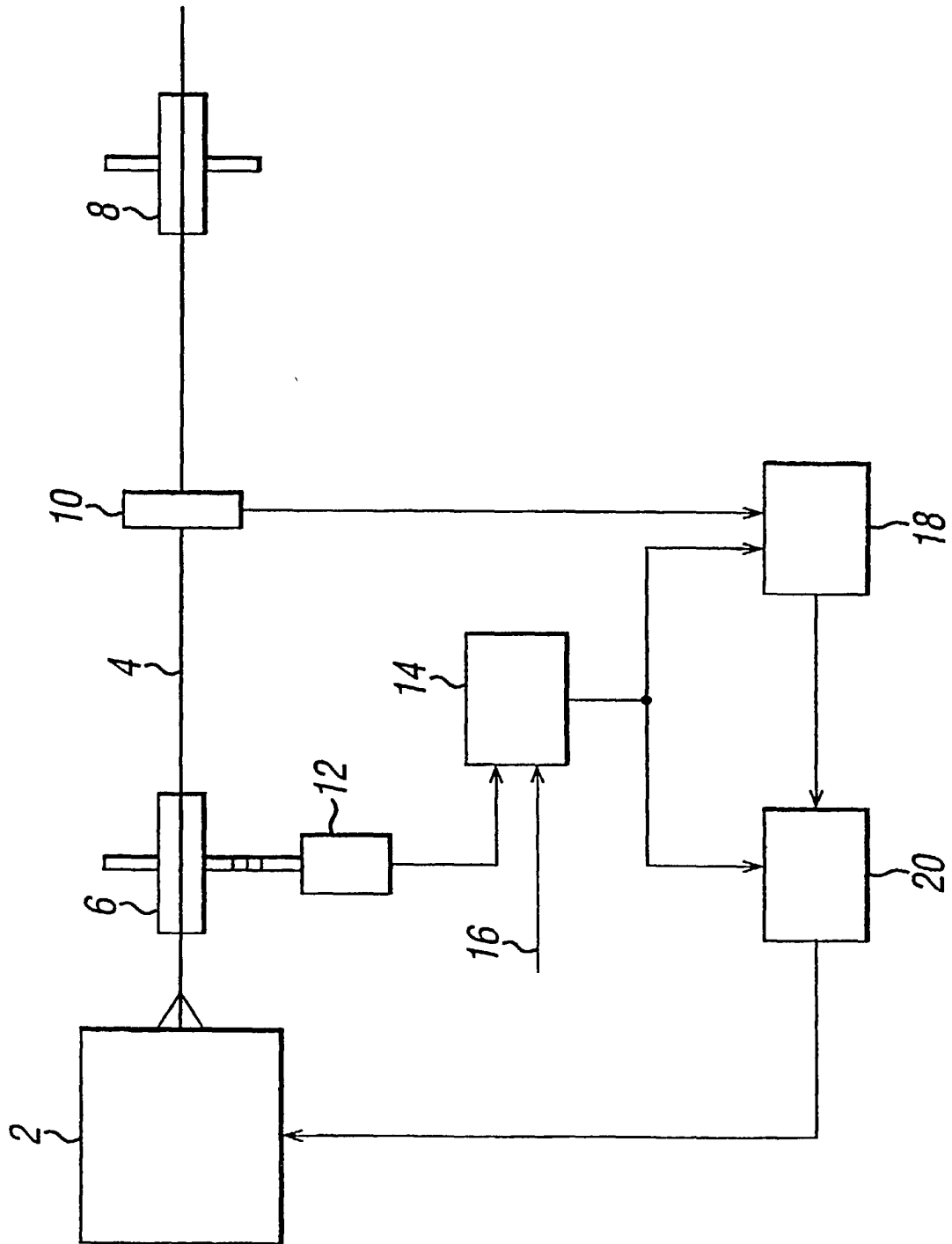


FIG. 2

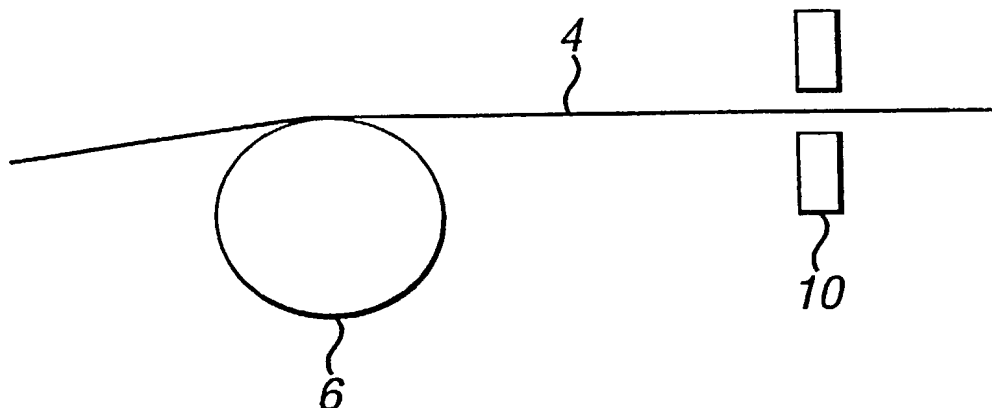


FIG. 3

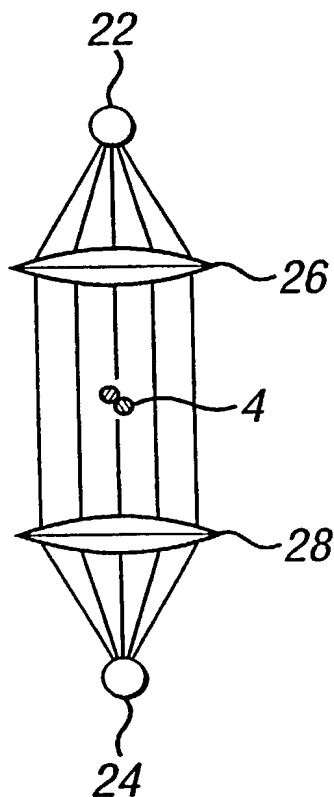
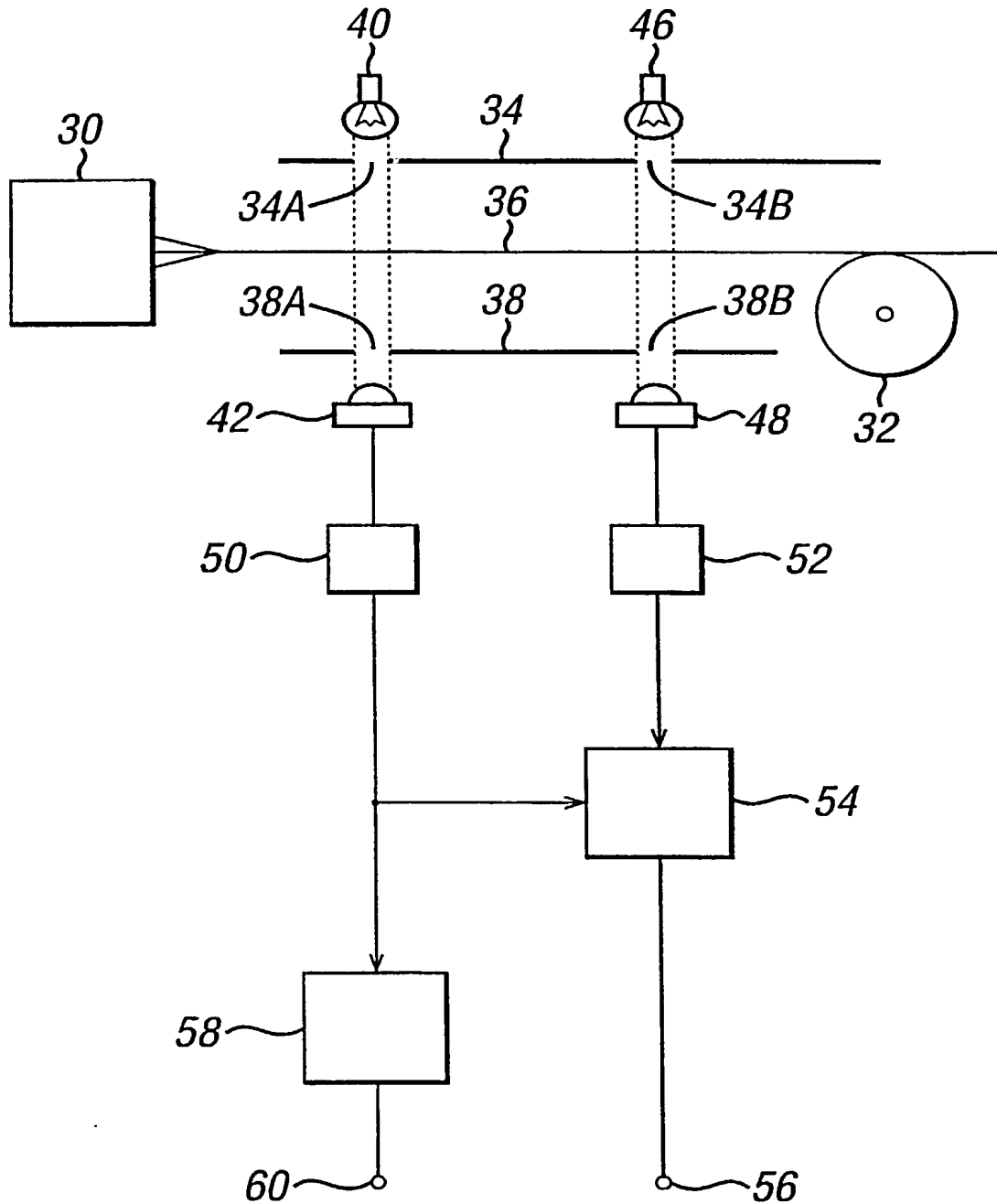


FIG. 4



Rev. 11/00

**DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION****PATENT**Docket No. : 47968/DBP/S307

As a below named inventor, I hereby declare that:

My residence, mailing address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled APPARATUS AND METHODS OF DETECTING AND CONTROLLING TWISTS IN MULTICORE CABLES, the specification of which is attached hereto unless the following is checked:

X was filed on August 30, 2000 as United States Application Number or PCT International Application Number PCT/GB 00/03902 and was amended on ____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C. § 119(a)-(d) or § 365(b) of the foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States of America, listed below and have also identified below, any foreign application for patent or inventor's certificate, or any PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

<u>Application Number</u>	<u>Country</u>	<u>Filing Date (day/month/year)</u>	<u>Priority Claimed</u>
9920588.2	Great Britain	1 September 1999	Yes

I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below.

<u>Application Number</u>	<u>Filing Date</u>
---------------------------	--------------------

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s), or any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. § 112.

<u>Application Number</u>	<u>Filing Date</u>	<u>Patented/Pending/Abandoned</u>
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POWER OF ATTORNEY: I hereby appoint the following attorneys and agents of the law firm CHRISTIE, PARKER & HALE, LLP to prosecute this application and any international application under the Patent Cooperation Treaty based on it and to transact all business in the U.S. Patent and Trademark Office connected with either of them in accordance with instructions from the assignee of the entire interest in this application;

**DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION**

Docket No. 47968/DBP/S307

or from the first or sole inventor named below in the event the application is not assigned; or from Saunders & Dollevmore in the event the power granted herein is for an application filed on behalf of a foreign attorney or agent.

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John D. Carpenter	(34,133)	Marc A. Karish	(44,816)	Richard A. Clegg	(33,485)
David A. Plumley	(37,208)	John F. O'Rourke	(38,985)	Natu J. Patel	(39,559)
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The authority under this Power of Attorney of each person named above shall automatically terminate and be revoked upon such person ceasing to be a member or associate of or of counsel to that law firm.

DIRECT TELEPHONE CALLS TO: D. Bruce Prout, 626/795-9900

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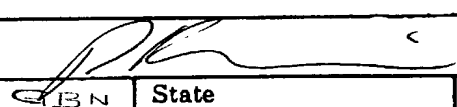
Customer Number: 23363

CHRISTIE, PARKER & HALE, LLP
P.O. Box 7068
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I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

**DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION**

Docket No. 47968/DBP/S307

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**DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION**

Docket No. 47968/DBP/S307

or from the first or sole inventor named below in the event the application is not assigned; or from Saunders & Dolley in the event the power granted herein is for an application filed on behalf of a foreign attorney or agent

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The authority under this Power of Attorney of each person named above shall automatically terminate and be revoked upon such person ceasing to be a member or associate of or of counsel to that law firm.

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Docket No. 47968/DBP/S307

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2 - 00

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